

# Guidelines for the Insertion and Management of Chest Drains

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**Guidelines for the Insertion and Management of Chest Drains**

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## **Guidelines for the Insertion and Management of Chest Drains**

### **1. Aim/Objectives/Introduction/Responsibilities**

#### **Aim**

To rationalise the use of chest drains throughout the organisation and standardise the care of the adult patient with a chest drain.

#### **Objectives**

1. To identify the need for a chest drain and select the appropriate drain and drainage system
2. To identify the safe insertion and subsequent removal of a chest drain
3. To ensure appropriate standardised documentation is used across the Trust
4. To identify appropriate training for all personnel involved in the insertion/management of chest drains

#### **Introduction**

##### General Principles

- Chest drain must only be inserted by competent staff members.
- Ultrasound guided chest drain insertion is strongly advised for fluid.
- Signed consent must be obtained prior to the procedure where-ever possible.
- Out of hours avoid chest drain insertion for fluid if the patient is clinically stable.

Chest drains are used in many different hospital settings and doctors in most specialties need to be capable of their safe insertion. Incorrect placement of a chest drain can lead to significant morbidity and even mortality (NPSA 2008 / RRR03).

These guidelines are aimed at the insertion and management of chest drains in the adult patient in a hospital environment. The scope of this guidance does not cover any other pleural procedures.

A chest drain is a tube inserted through the chest wall between the ribs and into the pleural cavity to allow drainage of air (pneumothorax), blood (haemothorax), fluid (pleural effusion) or pus (empyema) out of the chest. In any one patient it is essential to understand what the drain is aiming to achieve. The effective drainage of air, blood or fluid from the pleural space requires an adequately positioned drain and an airtight, one-way drainage system to maintain subatmospheric intrapleural pressure. This allows drainage of the pleural contents and re-expansion of the lung. In the case of a

pneumothorax or haemothorax this helps restore haemodynamic and respiratory stability by optimising ventilation/perfusion and minimising mediastinal shift.

## Responsibilities

It is the responsibility of each member of staff involved in the insertion and management of chest drains:-

- to comply with the standards set out in this guidance
- to work within their own competence
- to report all chest drain issues (including near miss events) using the Trust's Incident Reporting procedures

These issues should be discussed at relevant directorate Clinical Governance Groups and any identified actions resulting from incidents implemented.

It is the responsibility of each member of staff and individual clinical departments to ensure they adhere to the training and audit requirements set out in Section 4 of this guidance.

## 2. Indications for Use

Identification of the indication for a drain may be made by a combination of context (pathology, mechanism of injury), clinical examination and radiological imaging with more recently the use of bed side ultrasound examination. The use of ultrasound-guided insertion is strongly advised for pleural fluid (NPSA 2008, BTS 2010 Guideline)

Following full clinical assessment, if there is any doubt, further imaging should be arranged.

- Pneumothorax

Consider if Chest drain is required. Follow the BTS 2010 Algorithm

1. persistent or recurrent pneumothorax after simple aspiration
2. tension pneumothorax should always be treated with a chest drain after initial relief with a small bore cannula or needle
3. in any ventilated patient with a pneumothorax as the positive airway pressure will force air into the pleural cavity and quickly produce a tension pneumothorax
4. large secondary spontaneous pneumothorax (>2cm)
5. iatrogenic eg. following insertion of a central venous catheter. Not all will require drainage.

- Pleural fluid
  - Malignant pleural effusion
  - Simple pleural effusions in ventilated patients

- Empyema and complicated parapneumonic pleural effusion
- Traumatic pneumothorax or haemopneumothorax
- Peri-operative eg. thoracotomy, oesophageal surgery, cardiothoracic surgery

The urgency of insertion will depend on the indication and degree of physiological derangement that is being caused by the substance to be drained. In general drainage for pleural fluid should be avoided out of hours.

### **3. Insertion of a chest drain**

All personnel involved in the insertion of chest drains should be adequately trained and supervised. It has been shown that physicians trained in the method can safely perform the procedure with 3% early complications and 8% late (Collop,1997). With adequate training the risk of complications can be significantly reduced.

Insertion of a chest drain in a non-emergency situation will be a Consultant-led decision. It is the Consultant's responsibility to identify adequately trained doctors to perform the procedure.

A trained nurse should be present to assist in the procedure.

Insertion of a chest drain in an emergency situation will be the responsibility of the most senior, experienced available member of staff. Emergency insertions in trauma situations should follow ATLS (Advanced Trauma and Life Support) guidelines

Clinical assessment should take into consideration risk factors associated with insertion of a chest drain eg. clotting. Although there is no published evidence that abnormal blood clotting or platelet counts affect bleeding complications of chest drain insertion, it is good practice to correct any coagulopathy or platelet defect prior to drain insertion.

#### **Before insertion of the chest drain**

##### **Consent**

Written consent should be obtained whenever possible and documented as per Trust guidance. (PAT/PA 2 Policy for consent to examination or treatment) The identity of the patient should be checked and the site for insertion of the chest drain confirmed by reviewing the clinical signs and the radiological information.

##### **Aseptic technique**

All drains should be inserted with full aseptic precautions (washed hands, gloves, gown, antiseptic preparation for the insertion site and adequate sterile field) in order to avoid wound site infection or secondary empyema.

**Patient position**

The patient should be positioned appropriately; this will depend on the reason for insertion and the clinical state of the patient.

The most commonly used positions are either with the patient lying at 45° with their arm raised behind the head to expose the axillary area or in a forward lean position. The procedure may also be performed with the patient lying on their side with the affected side uppermost.

In trauma situations emergency drain insertion is more likely to be performed whilst the patient is still in supine position as part of the primary trauma survey.

**Premedication/local anaesthetic**

Chest drain insertion has been reported to be a painful procedure with 50% of patients experiencing pain levels of 9-10 on a scale of 10 in one study (Luketich, 1998) therefore analgesia should be considered.

Cleaning the skin with an antiseptic solution and adequate use of local infiltration of local anaesthetic (up to 3mg/kg of Lignocaine) allowing sufficient time to work is essential. Use of other parenteral analgesics is useful but will not provide sufficient analgesia alone. If sedation techniques are being used, the procedure should be performed with appropriate monitoring and resuscitation equipment immediately available.

Supplemental oxygen should also be considered (BMJ Career Focus 2004)

The following potential complications should also be considered

- incorrect placement (extrapleural, in the fissure, drainage holes outside the pleura, tube kinked)
- injury to intercostal vessels
- perforation of other vessels
- pain

(Laws et al, 2003)

All equipment required to insert a chest drain should be available before commencing the procedure.

**Chest drain tubes**

Chest drains come in a range of sizes suitable for a variety of purposes (typically 10-36Ch) and may be inserted via an open surgical incision (thoracostomy) or using the Seldinger technique incorporating a guide wire and dilator system.

The following chest drain tube sizes are available for use in adult patients within the Trust

12Ch  
18 Ch

20Ch  
28Ch  
32Ch

Small calibre drains (12Ch) are better tolerated and associated with less discomfort in spontaneous Pneumothorax and simple effusions but traumatic pneumothoraces, haemothoraces and empyemas may need larger drains.

### **Inserting the drain**

The position of the drain is determined by the location and the nature of the collection to be drained. The 5<sup>th</sup> intercostal space in the mid-axillary line is generally used for most situations. This area is commonly known as the “safe triangle”, bordered by the anterior border of latissimus dorsi, the lateral border of the pectoralis major, a line superior to the horizontal level of the nipple and an apex below the axilla. The drain should be inserted just above the rib.

Any other placement should be discussed with a senior clinician eg. in the presence of an apical pneumothorax, placement of a chest tube in the 2<sup>nd</sup> intercostal space should be considered. A specific position may also be required for a loculated effusion.

Aspiration of fluid or air confirms that the operator is in the pleural space and that it is safe to proceed. If fluid or air is not aspirated the procedure should not proceed and further radiological help sought. Aspiration is not required with open drain insertion.

If large bore chest drains are to be placed in the pleural cavity; significant force should never be used as this risks sudden chest penetration and damage to essential intra-thoracic structures. Open incision with blunt dissection of deep tissues with forceps or introducer-guided insertion of the drain is the preferred technique. The operator should ensure controlled spreading of the intercostal muscles on the superior surface of the ribs to avoid injury to the intercostal vessels and nerves that run below the inferior border of the ribs.

Alternatively a small bore chest drain using the Seldinger technique may be used.

All drain holes need to be in the pleural cavity for the drainage system to work effectively. If drain holes are situated within the subcutaneous tissues, air or fluid may escape into the tissues and cause surgical emphysema or collections of potentially infected fluid. Surgical emphysema is the abnormal presence of air within the subcutaneous tissues. Its presence suggests that the drain is occluded or misplaced. If neither is the case, then this means that the drainage system is inadequate to deal with the degree of air leak. The degree of drainage can be increased by applying suction, inserting a second drain or a larger bore tube.

Worsening surgical emphysema is uncomfortable, interferes with clinical examination of the patient and at its worst may track up to the neck and face,

potentially causing airway embarrassment.

### **The drainage system**

Once the drain is adequately inserted it should be connected to an appropriate closed drainage system determined by the clinical indication for insertion.

### **Passive drainage system**

This is an **underwater seal** drainage system which employs positive expiratory pressure and gravity to drain the pleural space.

The drainage tube is submerged to a depth of 2cm in the water of the reservoir / collection chamber\*. This ensures minimum resistance to drainage of air and maintains the underwater seal even in the face of a large inspiratory effort. The underwater seal acts as a one-way valve through which air is expelled from the pleural space and is prevented from re-entering during the next inspiration. Retrograde flow of fluid may occur if the collection chamber is raised above the level of the patient. The collection chamber should be kept below the level of the patient at all times to prevent fluid being siphoned back into the pleural space. If the underwater seal fails then air easily passes back up the tube during inspiration and the lung will collapse.

Drainage can be allowed to occur under gravity or suction may be applied (see section 7).

Underwater seal units used within the Trust are the Thora Seal I (used primarily in surgery) and the Thora Seal II (used in all other specialties).

\* The Thora Seal II has a pre-marked fluid level on the collection chamber.

### **Portable valve systems**

These should be used for patients with on-going air leaks or fluid drainage. These are based on a one-way flutter system which theoretically may be advantageous as resistance to airflow is generally lower than with conventional underwater seal units.

The Portex Ambulatory chest drainage system is available for use in the Trust. This is a "no water" ambulatory bag system which incorporates a one-way valve and can be used in the hospital environment or at home for patients requiring long term pleural drainage.

Large pleural effusions should not be allowed to drain all at once. The rapid shift in pleural pressures and re-expansion of the previously collapsed lung can cause re-expansion pulmonary oedema, a potentially fatal complication.

No more than 1-1.5 litres of fluid should be allowed to drain slowly before the tube is clamped. If the patient starts to cough or complains of chest pain before this point is reached, drainage should be stopped and may be resumed a few hours later.

### **Securing the chest drain**

Chest drains should be secured with 1/0 silk suture anchored to the skin and the drain with a suitable non slip knot technique. This should prevent excessive travel of the drain in and out of the chest wall. The skin incision can be closed each side of the chest tube usually with one 2/0 silk suture each side. Nylon/Ethilon can be used but is more difficult to tie. The operator needs to be able to tie sutures securely. Modified techniques may be used if approved by Consultant staff skilled in the insertion and management of chest drains.

Purse string sutures should be avoided as they convert a linear wound into a circular wound which can be painful and leave an unsightly scar (Tomlinson, 1997).

### **Dressings**

Purpose designed dressings should be used ie. "Drainfix" for small bore drains and "Mefix" for large bore drains.

Large amounts of tape and padding to dress the site are unnecessary and may restrict chest wall movement or increase moisture collection. Dressings should allow sound site inspection and drain connections should not be covered.

An "omental tag" of adhesive dressing tape may be used to support the tube and protect it further against being pulled out.

**Following insertion of the chest drain** it is essential to :-

- check the underwater seal oscillates during respiration
- order a repeat chest x-ray to confirm the position of the tube and the degree of lung re-expansion and exclude any complications
- advise the patient to keep the underwater bottle upright and below the drain insertion site.
- ensure regular analgesia is prescribed whilst the chest drain is in place
- ensure all sharps disposed of in accordance with the Trust policy
- document the procedure in the patient's medical and nursing records as per Trust guidance. The batch number of the chest tube/drainage system, the position of insertion and the length of the tube after insertion should be documented
- provide the patient with a patient information leaflet

Any changes to the chest drain/drainage system following initial insertion should be clearly documented.

## **4. Training/Audit**

Individual clinical departments should specify what level of seniority is expected to insert chest drains and should be indicated in relevant induction programmes. It is the clinical specialty's responsibility to assess and evidence staff competence.

Post-graduate teaching programmes are available for the simulated practice of chest drain insertion using the seldinger technique.

In addition the following training opportunities are available within the Trust

- ALERT (Acute Life Threatening Events Recognition and Treatment)
- Clinical Skills Laboratories
- RAMSI (Recognition and Management of the Seriously Ill Patient)

Tyco Healthcare provides a training programme and competency assessment for equipment used within the Trust

All staff involved in the insertion and management of chest drains should access this training with formal assessment of competence.

The Trust Clinical Procurement Specialist is also provides valuable training in the management of chest drains.

Training should be carried out in accordance with the Trust's Medical Device Training Strategy.

It is the responsibility of each clinical specialty to ensure any patient with a chest drain should be cared for by staff adequately trained in the management of chest drains eg. all patients with chest drains within the Medical Directorate at Doncaster Royal Infirmary should be cared for on Ward 26 or the Medical Assessment Unit.

### **Audit**

Regular audit should be carried out by individual clinical departments to monitor compliance with this guidance.

## **5. Monitoring/Recording**

A Trust Chest Drain Observation Chart (Appendix 1) should be commenced for every patient with a chest drain. The frequency of observations depends on clinical presentation/progress and medical request but should happen hourly for the first 4 hours immediately following chest drain insertion and then at least 4 hourly.

Fluid within the tube should swing with respiration due to changes in intra-pleural pressure. With normal respiration, the fluid should rise on inspiration and fall on expiration.

Bubbling and swinging are both dependant on an intact underwater seal and so can only be picked up if the drain tube extends below the water level in the bottle. Bubbling and swinging should be assessed with the patient deep breathing and if possible coughing. This also has the benefit of assessing adequacy of analgesia. These features indicate that the drain is still functioning.

Absence of swinging indicates that the drain is occluded or is no longer in the pleural space. It may be necessary following clinical assessment and unsuccessful flushing of the drain to obtain a chest x-ray to determine the underlying cause.

Bubbling in the underwater seal fluid chamber generally indicates an on-going air leak which may be continuous, present on one phase of spontaneous respiration or only on coughing. Persistent bubbling throughout the respiratory cycle may indicate a continuing broncho-pleural air leak. Faulty connections and entrained air through the skin incision should also be assessed.

A drain inserted for a fluid collection such as an effusion or empyema will need the volume and nature of the drained fluid recording. Drains inserted just for fluid should not bubble so the presence of this feature is abnormal and should be recorded. Any abnormal signs or complications should be referred for medical review.

A drain inserted for drainage of a haemothorax (+/- pneumothorax) needs blood loss to be recorded accurately with any sudden increases in drain volume referred immediately for medical review.

With fractured ribs most bleeding is from the intercostal vessels, which slows down as the lung reinflates. However continued bleeding into the drain bottle is indicative of pathology that may need thoracic surgical intervention. After thoracic trauma more than 1500ml of blood into the bottle initially or continued bleeding of greater than 200ml/hr requires discussion with the thoracic surgeons.

To ensure patency small bore drains should be flushed regularly with Normal Saline; the flush should be prescribed and carried out by appropriately trained personnel.

Full respiratory and cardiovascular observations should be carried out and documented.

## **6. Management of the chest drain and drainage system**

Examination of the patient from the patient to the drainage bottle should take place regularly to inspect all aspects of the patient and the drainage system.

### **Clamping Chest Drains**

As a general rule chest tubes for pneumothorax should not be clamped. Exceptions to this may be when the drainage bottle requires replacement or when testing the system for air leaks. Clamping a pleural drain in the presence of a continuing air leak may result in a tension pneumothorax or possibly worsening surgical emphysema. A bubbling drain therefore should never be clamped.

If a chest tube is clamped it should be under the direct supervision of a respiratory physician or surgeon on a ward with experienced nursing staff. A patient with a clamped tube should not leave the specialist ward environment. Instructions should be left that if the patient becomes breathless or develops surgical emphysema, the chest tube must be unclamped immediately and the medical team alerted. In cases of pneumothorax there is no evidence that clamping a chest drain at the time of removal is beneficial.

Drains for fluid drainage can be clamped or closed to control drainage rate as necessary.

### Changing the drain bottle

Temporary clamping of the drainage tube may be necessary when changing the drain bottle to prevent ingress of air into the pleural cavity. If a 3 way tap is fitted then this can be switched off. This has the advantage of removing the risk of inadvertently leaving the tube clamped. Local policy should be followed with regard to asepsis and infection control.

### Suction

A patient who is free from pain, to the degree that an effective cough can be produced, will generate a much higher pleural pressure differential than can safely be produced with suction. This combined with a functional underwater seal will result in re-inflation of the lung. If a patient cannot re-inflate his own lung or persistent air leak is preventing re-inflation, **high volume, low-pressure** thoracic suction in the range of 3-5kPa (approx 30-50cmH<sub>2</sub>O) should be used. Prescription of suction is a medical responsibility. Purpose made low grade suction units (max 30kPa) should be used when applying to a chest drain. Standard high volume, high-pressure suction units should not be used because of the ease of which it may lead to air stealing and hypoxaemia, the perpetuation of persistent air leaks and possible damage to lung tissue caused by it becoming trapped in the catheter (Henry et al.,2003: Munnell, 1997). Suction that is not working properly or is turned off without disconnecting from the drain bottle is the equivalent of a clamped drain, so when suction is no longer needed it should be disconnected from the drainage bottle.

The use of suction may cause continuous bubbling from the tube; movement/swinging of fluid in the tube may not be visible.

Low grade suction units are available from Ward 26 at Doncaster Royal Infirmary and the Medical Equipment Library at Bassetlaw Hospital.

### Mobility

If appropriate, patients should be encouraged to walk around. If the drain is on suction the patient will be restricted to the bedside.

### Dressings

Dressings should be changed daily for the following reasons:-

- to enable the insertion site to be monitored for signs of infection. A swab should be taken from the chest drain site if there are any clinical signs of infection

- to monitor for surgical emphysema
- to ensure the chest drain remains well placed and the anchor suture is in tact

### **Analgesia**

Breathing with a chest tube in place can be painful and adequate analgesia should be prescribed on a regular basis.

### **7. Removal of the chest drain**

The timing of removal of the chest drain is dependant on the original reason for insertion and clinical progress.

Adequate pain relief should be ensured before removal of the chest drain. As for insertion, an aseptic technique should be used for removal and the chest drain and drainage kit disposed of appropriately.

When the tube is ready to be removed, the patient should be asked to perform a Valsalva manoeuvre (to increase the pleural pressure and prevent air entering the pleural cavity) and the tube is withdrawn quickly. The previously placed suture is then tied to close the hole. The operator should be able to tie sutures securely.

The wound site should be checked, condition documented and an appropriate dressing applied.

An x-ray should be performed following removal of the chest drain to ensure resolution of the original pathology.

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BTS 2010 Algorithm - [www.brit-thoracic.org.uk](http://www.brit-thoracic.org.uk)